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Learning from fellow engineering students who have current professional experience

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In this paper we present an investigation of how experience-led content in an engineering degree can be strengthened by creating opportunities for engineering students to benefit from the knowledge, skills and resources of students with current professional experience. Students who study civil engineering part-time at Coventry University (while also working in the industry) are being used as mentors for full-time students, and careful attention is being paid to the input they can make to group project work. This paper reviews the results of evaluations of these two initiatives. The clearest enhancement to learning provided by the part-time students in these settings is the access they provide for the full-time students to real examples, and the provision of actual physical artefacts such as drawings, photos, example documents and templates. Full-time students also gain an awareness of the value of the professional skills. The study confirms the value of these initiatives and points to future improvements.

Keywords: experience-led engineering degrees, part-time students, mentoring, group projects, professional skills

1. Introduction

The UK Royal Academy of Engineering (2007) has stressed that universities and industry need to find more effective ways of ensuring that course content reflects the real requirements of industry, and (2010) has presented case studies relating to ‘experience-led’ engineering degrees. These include realistic project work, industrial simulation, inputs from practitioners, and work experience.

In courses where a proportion of the student cohort has high levels of current professional experience, an additional way of strengthening the experience-led nature of an engineering course is by using the knowledge, skills and resources of those students. In this paper we present an investigation of how learning can be enhanced by creating structured opportunities for engineering students to benefit from the industry experience possessed by some of their colleagues. It studies two initiatives which have the aim of creating beneficial contact between those with engineering experience and those without. The overall aim of the paper is to make a contribution to understanding how the experience-led content of engineering degrees can be enhanced.

The context of these initiatives is the civil engineering programme at Coventry University in the UK where about one-third of students study part-time, attending the University on day release and working in the industry on the other four days of the week. This is a particular characteristic of the Coventry provision which is shared with some other universities in the UK, though the majority offer only full-time courses in civil engineering.

The two initiatives are:

- (1) a scheme in which part-time students act as mentors to full-time first year students;
- (2) a managed approach to group formation for project work in later years of the course that takes account of the potential benefits of part-time and full-time students working together.

Both initiatives were evaluated after the first year of operation in order to aid their development. This paper is based on the data from these two studies. It reports on the evaluations, and reflects on their findings, when taken together, in order to answer the following questions.

- How do the full-time students learn from part-time students?
- What are the benefits and problems in creating this contact?

The methodology was in part determined by the need to evaluate the two initiatives. Data for evaluation of the mentoring scheme was collected using questionnaires and facilitated discussions involving the mentors (part-time students) and a sample of mentees (full-time students). The questionnaires had a combination of closed and open questions. Reference was also made to brief statements recorded by the mentors before the start of the scheme. Data for evaluation of the group project work was collected using semi-structured individual interviews of a sample of full-time and part-time students. To answer the specific research questions (as opposed to evaluating the separate initiatives in their own right) analysis of the data was based on identification of themes that were common to both sets of data and a comparison of the key points.

2. The opportunity

A significant number of students on the undergraduate BEng in Civil Engineering at Coventry University are part-time students in the work-force. This course can be taken over 3 academic years on a full-time basis, or 5 years part-time. The proportion of the total cohort varies; in the last 5 years it has been between 30% and 40%. The remaining students study full-time and have the option to take a year out in industry (between years 2 and 3 of study) or find relevant vacation work experience; but many do not, partly because opportunities are currently limited because of a downturn in the UK construction industry.

A study by Davies (2008) has demonstrated that part-time students on this course outperform full-time students academically in spite of having generally lower qualifications on entry to courses. It attributed much of this relative success to the skills, attitudes and motivation that part-time students have developed in the work-place. The study emphasised the importance of course teams seeing part-time students as a resource.

Since the 2008 study, two initiatives have been introduced at Coventry which recognise the resource provided by part-time students. These are now described.

2.1 Mentoring

Full-time students at Coventry take 5 ECTS credits each year in the form of University-wide employability modules. Part-time students are exempt. In place of these modules, part-time civil engineering students gain the extra credits they need in the form of 'Contact with Practice' (CP) credits. To earn CP credits, students arrange an event or experience, such as a site visit or workplace visit, that will benefit full-time students by giving them a flavour of the civil engineering profession – a contact with practice.

In 2010/11 the CP credits scheme was extended to enable part-time students to act as mentors for full-time first year students. The aim was, by giving the first year students the opportunity to have structured contact with practising professionals close in

age and outlook to themselves, to harness the knowledge and experience of the part-time students in order to enhance the full-time students' awareness of the civil engineering profession and of the skills required for success. Part-time students were free to choose mentoring from the range of options for achieving CP credits. First year full-time students volunteered to be mentored. The part-time students received training in mentoring and then, working in pairs, met regularly with a group of 4 or 5 first year students. In the first year of operation (2010/11), 6 pairs of part-time students acted as mentors to a total of 27 first year full-time students. The students were free to structure the meetings as they wished, but were encouraged to discuss the world of civil engineering (as experienced by the part-time students) and also the course itself. In this latter respect, it was hoped that the part-time students could offer guidance both from their greater experience of the course, and from their perspective as student-professionals.

2.2 Group project work

The main focus of efforts to form student groups that take account of the potential contributions and roles of part-time and full-time students has been a project entitled Integrated Project, in year 3 of the course. This is a realistic design and construction project, with a brief based on a real case, and supported by inputs from practitioners and by real site data. In 2010/11, part-time and full-time students were deliberately mixed in the group formation process. In previous years a variety of approaches to group formation had been used.

A further study of group formation within the civil engineering provision at Coventry (this time for a civil engineering feasibility study carried out in year 2 entitled Engineering Investigation) has been carried out by Trujillo (2011). This is considered in the literature review.

3. The literature

The literature relevant to this investigation is presented below under the main headings of: development of professional attributes, characteristics of part-time students, peer support, and composition of student project groups.

3.1 Development of professional attributes

Two reports by The Royal Academy of Engineering (2007, 2010) have focused on preparing engineering students and graduates for modern engineering challenges and have promoted the concept of 'experience-led' engineering degrees. Many other commentators have also referred to the processes by which engineering students develop the attributes of practising engineers. For example, Lindsay *et al.* (2008: 29) identify the distinction between an 'engineering student' and a 'student engineer', and describe how (at Curtin University of Technology, Australia) they provide a learning environment which is 'designed to be as authentic a representation of an engineering workplace as possible'. They see this as relating to learning and also to behaviours (of typical students compared with professional engineers). Poitras and Poitras (2011: 64) use the educational concept of 'cognitive apprenticeship', in supporting the

development of engineering students' use of authentic practices in a way similar to craft apprenticeships.

3.2 Characteristics of part-time students

Schuller *et al.* (1999) present an extensive study of part-time higher education in Scotland in a variety of subjects including engineering. They report a staff perception that part-time students in general are more committed and motivated than full-time students. They also found that 'part-timers were more likely to have a sense of where their occupational career might be leading and the role which education might play in this' (p159).

Brennan *et al.* (1999) surveyed 6000 part-time students, including engineering students. The results suggested that there were substantial personal economic benefits to be gained from engaging in part-time study, with the majority of respondents able to obtain better jobs and salaries at the end of their courses than at the beginning.

Many other studies of part-time students (in any subject) focus on the problems and challenges of part-time study without much consideration of the advantages. For example Kember and Leung (2004) and Yum *et al.* (2005), who studied part-time students in a range of subject areas in Hong Kong, consider the employment of 'coping mechanisms' by part-time students and identify the sacrifices that must be made. Nicholl and Timmins (2005), studying nursing students in the UK, concentrate on the high levels of stress experienced by part-time students. The paper makes no comment on any potential advantage of being a part-time student and does not, for example, probe areas in which part-time students might feel less stress than full-time students.

Davies (2008) studied part-time civil engineering students at Coventry University. The study indicated a significantly higher level of performance overall by part-time students. Some part-time students and graduates described gaining benefits from the juxtaposition of academic learning and professional application, providing them with a practical context for their education, but some other part-time students did not feel they experienced this (often because their work specialisation was not strongly related to the course content). All tended to have high levels of commitment to their studies which partly arose from the fact that most chose civil engineering as a *job* before they chose it as an academic subject. However, the consensus from the interviews was that the greatest advantage came from the skills, attitudes, and motivation that part-time students had developed in the workplace.

A recent large scale study of part-time students in employment in the UK (Callender *et al.* 2010) covering a wide range of discipline areas (including engineering) has similarly identified the significance of the link between commitment to studying and career ambitions. For the vast majority of part-time students surveyed, the decision to study and choice of subject were firmly linked to career aims. Mason and Hopkin (2011) consider the perspective of employers, and found strong support for the combination of work experience and study experience by part-time students in the workforce.

3.3 Peer support

Black and MacKenzie (2008) give a comprehensive review of peer support, concentrating on the first year of HE courses. They distinguish between peer *tutoring*,

where the primary aim is academic, and peer *mentoring* which is more concerned with orientation and integration within university life. The peer-assisted learning (PAL) scheme at Bournemouth University (Green 2007) is an example of an approach that combines peer tutoring and peer mentoring, and involves experienced students ('PAL Leaders') facilitating weekly or fortnightly study support sessions for students in the year below. More firmly in the realm of peer *mentoring* is a scheme at the University of Salford (Joddrell 2007) where built environment students in year 2 are trained in mentoring and then act as mentors to year 1 students as they carry out project work. In these cases peer mentoring requires mentors to have some relevant experience that they can share with others.

3.4 Composition of student project groups

Comments in the literature on the composition of student groups in project work are almost as numerous as the articles that describe project work. Two contrasting examples are given below from a recent symposium on problem-based learning.

In their 'group performance model', Bird and Iqbal (2011: 546) place the emphasis on developing 'common ground'. They found that 'stronger performing groups unequivocally indicated the extent to which they had achieved "common ground".' However, Tozawa (2011: 303) emphasises the value of differences among group members. 'A PBL team containing members with different backgrounds has the advantage that there are variations of thought in the team.'

Of direct relevance to the current investigation is a study by Trujillo (2011) relating to project work in civil engineering at Coventry University. Whereas the current investigation considers project work at year 3 of this course, the study by Trujillo is of project work in year 2, the Engineering Investigation. Working in groups of 5, students develop proposals for sustainable regeneration of a brownfield site. The cohort contains the mix of full-time and part-time students already described. In 2009/10 students had been free to form their own groups, and the part-time students had all chosen to work with other part-time students. In 2010/11 students were placed in mixed groups (based on a skills audit of all students) and part-time students were distributed between groups.

In 2009/10, the average mark for part-time students was 10.6% higher than the average mark for all students, and the average mark for full-time students was 3.0% lower. In 2010/11, the average mark for part-time students was 6.9% higher than the average mark for all students, and the average mark for full-time students was 0.5% lower. (Trujillo presents a more detailed break-down, but we concentrate here on the contrast between part-time and full-time students overall.) While not proving the value of any particular approach to group formation, this study certainly suggests there is merit in considering the composition of groups in terms of mixing those who have current experience of the industry with those who do not, even though the benefits (in terms of marks at least) appear to go to those without the experience.

3.5 Outcomes of the literature review

This review of relevant aspects of the literature points to the significance of the professional skills already possessed by part-time students in relation to the development that all engineering students must undergo in developing from students to engineers. It sets out the context in which students may act as mentors for fellow

students. It provides confirmation that composition of groups can have an effect on aspects of group project work. No close equivalents of the initiatives involving part-time students carried out at Coventry have been found in the literature, and this confirms the validity and interest of the research questions posed for this investigation.

4. The studies

We now consider data collected in two separate evaluation studies. The first was a study, carried out in 2011, of the effectiveness of the mentoring scheme in its first year of operation. The second was a study of the Integrated Project in year 3 (also carried out in 2011), focusing particularly on the interaction between part-time and full-time students in mixed groups.

4.1 Study of mentoring scheme

In the scheme in which part-time students acted as mentors to full-time first year students, 12 part-time students volunteered to be mentors in 2010/11 (about half of the part-time cohort). They were asked at the start to complete a brief written record of their motivation and hopes.

Mentors were asked 'How would you describe the main role that a student mentor can play in supporting new first year students?' Nearly all the responses related to sharing real world experience and skills. For example,

'Demonstrating a professional mentality in approach to all tasks. If first year students will learn this approach they can achieve more at uni[versity].'

Nearly every answer to the question 'What strengths do you bring to the mentoring programme?' contained the word 'experience'.

'Experience of the work place environment. Application of real life examples of how the real world applies to what we're learning in the classroom'

The scheme was evaluated at the end of its first year of operation. At an evaluation meeting, all 12 mentors completed a questionnaire and took part in a facilitated discussion. At a separate meeting, a sample of 5 mentees completed a questionnaire and took part in a facilitated discussion. A similar questionnaire was used for mentors and mentees. The questions covered overall perception of the scheme, the topics discussed, and perceived benefits. The discussions were facilitated by the organiser of the scheme, and covered overall perception, benefits, topics covered, the nature of the discussions and detailed arrangements.

The mentors (11 male and 1 female) were all part-time students employed in the civil engineering industry. Their ages ranged from 22 to 31. All were from the UK. The mentees in the sample (4 male, 1 female) were year 1 students without relevant work experience. Four were aged 18 or 19, one was 28. All were from the UK.

The main findings are now presented under the general themes of

- Overall perception by mentees of effectiveness
- Topics covered in group discussions
- Benefits for mentors

4.1.1 Overall perception by mentees of effectiveness

Responses from mentees about whether the scheme was a good idea, and whether it had lived up to expectations, were unanimously positive. Responses to ‘What do you think you got out of having a mentor?’ included:

‘Gaining a better understanding of what life is like in employment and an idea of how I can prepare myself for future employment, qualities, etc.’

4.1.2 Topics covered in group discussions

It had been felt that mentors could provide an insight on the industry but also on the course. To determine the relative time spent on these topics, mentors were asked in the questionnaire to indicate the breakdown of time for topics at the meetings. The responses are on Table 1. All mentors discussed both their work and the course either ‘some of the time’ or ‘most of the time’. For 10 (83%) of the mentors, work was the dominant topic, for 2 (17%) it was the course.

[Table 1 near here]

To uncover more detail, mentors were asked more specifically about the ways they had discussed their work. Results are on Table 2. Straightforward description of projects appeared to have had most success, with more subtle aspects concerning teamwork and roles within a team having slightly less success. Sample drawings and photos of site work were well received.

[Table 2 near here]

Mentors were asked whether they provided advice on interpersonal and organisational skills. The results are on Table 3. Again there was slightly less success in these areas than when simply presenting projects, but still some success.

[Table 3 near here]

The mentees confirmed that the groups talked more about life in industry than the course. They welcomed the opportunity simply to find out what work is like, and to be exposed to specific examples of engineering projects, but were aware that the part-time students also wanted to communicate the importance of professional skills.

‘... some of their experiences ... good to hear about it, like how they described what problem they were set, how they went about it ... teamwork – they kept going on about that ...’

When asked who took the lead in meetings and whether it fell to the mentors to guide the group discussion, mentors made it clear that there was no imbalance between mentors and mentees in taking the lead or keeping the discussion alive.

‘They had plenty to ask ... I think actually it was more them leading’

4.1.3 Benefits for mentors

When mentors were asked what they got out of the scheme themselves, there was some agreement that the experience improved professional skills, but this was not strong.

Most mentors derived personal satisfaction from the experience. Responses to ‘What do you think you got out of being a mentor?’ were generally positive.

4.2 Study of mixed groups for project work

This study was of the student experience in the year 3 Integrated Project and focused particularly on the interaction between part-time and full-time students in mixed groups. Individual semi-structured interviews were held with 22 students taking part in the project (about 15% of the cohort), of which 17 were full-time and 5 were part-time. Of the full-time students (11 male, 5 female), two had relevant work experience through year-out placements, and three others had significant work experience in a different area. Most were aged between 21 and 23, though three were significantly older (30, 41, 46). Two were international students, 10 were from the UK, and five from other parts of Europe. The part-time students (4 male, 1 female) were all employed in the industry. Their ages ranged from 23 to 28. All were from the UK.

The interviews were carried out by a researcher not involved with the organisation of the project, in order to encourage open and frank responses from the students. Topics included the design of project, the most challenging aspects, the group work experience, contributions by part-time and full-time students, and aspects of project supervision.

4.2.1 Full-timers’ views

There was a strong consensus among full-time students that they benefitted from having part-time students in their group. The main benefits cited were the part-time students’ access to example documents and resources from work, their industry experience, and their organisational and time-management skills.

It was clear that part-time students contributed significantly by bringing in example documents and templates from work.

‘They’ve been able to get some example documents that we can take some inspiration from’

At a practical level, full-time students recognised that they benefitted from the fact that part-time students could support their teams by performing various tasks using their employers’ facilities: CAD software, printing and binding, for example.

By contact with the part-time students, it is clear that full-time students could see the value of industrial experience. Several full-time students were aware that the realistic project work was making use of knowledge that the part-time students possessed from work, but that they (full-timers) had not gained from their university studies up until the project.

‘[They have] just a bit more knowledge than really otherwise we would have had from just being taught in a university environment’

From a tutor’s point of view there is a risk that part-time students might detract from full-time students’ confidence to contribute, but only one full-time student (unwittingly) gave clear evidence of that danger.

‘If we had issues which we were unsure of we could always ask them and they would say “OK this is what we do, this is how it’s done” ’

Other full-time students were confident that they were making a full contribution.

'They've got a job, but I've got another job which is studying full-time'

Only two full-time students did not express positive feelings about the impact of part-time students. One felt that a part-time student in the group was inflexible.

'This is how it's done in industry – agree with it.'

The other felt that the part-time student in the group only wanted to pass, and did not have ambitions for high marks. But earlier findings (Davies 2008) suggest that low levels of ambition among part-time students are not typical.

4.2.2 Part-timers' views

Part-time students were aware that they had experience, knowledge, and an understanding of how to approach engineering tasks, which the full-time students did not have.

'... not just the knowledge, it's the way of thinking'

Because of their experience it was common for part-time students to provide a certain degree of leadership within a group. It was clear that when part-time students were placed in a coordinating role, or assumed such a role, they were often able to set standards and provide guidance using their knowledge and experience from professional practice. They also mentioned being able to bring in examples and templates from work.

'... when you're in the centre like that you can see the difference in standards between everyone's work. At first I'd send it back giving a detailed list of the things they needed to change. For some people I could send an example report so they could see what something at work should look like.'

They were aware of their greater understanding of how to conduct a meeting. Some tried to exercise skills in encouraging inputs from all group members; others described trying not to take control at first, but feeling in the end that they needed to:

'We want to get it done so we might as well start talking and try and sort things out'

Some part-time students felt they had benefitted from the project work in mixed groups in terms of personal and professional development (but this view was not shared by all the part-time students interviewed).

'... in terms of personal development of skills, in terms of engineering skills and knowledge, the less experienced people in the group [full-time] may benefit from learning quite a lot, whereas maybe the more experienced [part-time] will gain from having to almost guide, mentor the less experienced members in the group'

Part-time students needed to spend extra time providing guidance, and this was generally an area of dissatisfaction for them. There was a clear awareness that marks were at stake and time was limited.

One of the part-time students was completely negative about the contact with full-time students, describing their lack of practical knowledge as 'an extra burden' for part-timers.

5. Discussion

5.1 Limitations of study

This discussion is a reflection on the outcomes of these evaluations. We acknowledge two clear limitations in our approach. First, these initiatives and evaluations have been at a single institution. Second, in both evaluations the sample sizes have been modest:

for the mentoring scheme the sample was limited by the size of the group participating in the initiative; for the group project it was limited by the resources (researcher time) available for carrying out the interviews. In spite of these limitations the studies have allowed early evaluation of the two initiatives, and provide a suitable basis for valid responses to be made to the research questions posed in the Introduction.

5.2 How do full-time students learn from part-time students?

In the mentoring groups both mentors and mentees describe particular success in discussing current and past projects at work, supported by drawing and photos. There was also reported success in discussing team roles and professional skills, but less than in simply presenting projects.

In the group project work, the main benefits cited by full-time students of having part-time students in their group were the part-time students' access to example documents and resources from work, their industry experience, and their organisational and time-management skills.

Taking these two cases together, it appears that the clearest enhancement to learning provided by the part-time students in these settings is the access they provide for the full-time students to real examples, and the provision of actual physical artefacts: drawings, photos, example documents and templates.

The value of this should not be underestimated. The value of 'experience-led' content in an engineering degree is recognised (Royal Academy of Engineering 2010). The part-time students have the potential to bring the real world of engineering with them to university and they do this literally – by providing actual physical examples. Part-time students can help to create the environment in which the full-time students learn, or construct their understanding; and in this case the environment is most effective if it is enhanced by physical examples from real engineering.

Full-time students learn from the knowledge and experience of the part-time students. In the mentoring scheme this is evident in discussions about the relevance of the course to work in the profession. In project work it is evident in the process of sharing and developing ideas. In some cases, in project groups, full-time students have also been exposed to part-time students' expectations of standards.

The full-time students learn from the part-time students by gaining an awareness of the value of the professional skills that the part-time students have developed at work and that they describe at mentoring meetings or display in group project work. However, there is no reason to suppose that full-time students develop their own skills through this contact with the part-time students. If the skills and motivation of the part-time students have been developed in the workplace, then there is no reason to suppose that this will easily 'rub off' on to full-time students. Full-time students will have to develop these skills in the workplace in the same way that the part-timers have. The statement '... teamwork – they kept going on about that ...' from one of the first year mentees suggests an appreciation of the importance of this professional skill that has come from listening to advice but not from first-hand experience. But full-time students who have worked in project groups with part-time students can see what these skills mean in practice and will have developed an expectation that they themselves will gain, and benefit from, those skills when they start full-time work. The experience has increased full-time students' awareness of the nature and value of professional skills and their role in the development of a professional engineer.

This complements other aspects of the course in which the importance of professional skills is emphasised. Part-time students can play a significant role, but are not the only contact that full-time students have with the professional world. Input from practising engineers, industry visits, case studies, the role of academic staff (60% of whom are professionally qualified), and opportunities for work experience are components in this.

5.3 What are the benefits and problems in creating this contact?

Development of professional attributes is part of a journey to becoming an engineer, and, in general, part-time students have travelled further in this journey than full-time students. Full-time students must make this journey for themselves, but part-time students can help them by being providers of physical examples, describers, guides and role models; they can share expertise and demonstrate skills. This is where the benefits to full-time students lie.

There is evidence that full-time students took an active rather than passive interest in the part-time students' professional identity. In the mentoring sessions mentors and mentees made equal contributions to leading the discussion. In mixed project groups it is harder to generalise. It does appear that some full-time students tended to simply accept that part-time students knew best about practical engineering, but others were both confident in their own contributions and appreciative of the part-timers' perspective. These differences may result from the significant spread of age and work experience among the full-time students interviewed.

For the part-time students, the contact with the full-time students in the mentoring scheme and in project groups constitutes some degree of professional and personal development. In project groups it is clear that part-time students take the lead in certain circumstances and this comes about as a result of their professional experience and skills. Some saw this as a development opportunity but others resented having to do it. In fact there may be more personal development taking place for the part-time students in this context than they themselves realise. At work, though some may be in a position in which they provide leadership for colleagues, most (at this stage in their careers) will not be.

A problem with the role of part-time students in group project work is a conflict relating to motivation. They may feel they have something to offer full-time students, and may gain satisfaction from sharing their knowledge, but their fundamental motivation is to maximise their own mark for the project and this can cause frustration, or reluctance to spend too much time helping others, or even resentment. The mark allocation in future years is to be adjusted in an attempt to reward individual contributions within groups to reduce this conflict.

A potential problem is that project work groups containing part-time students do not start with an equal level of 'shared ignorance'. This became evident in the interviews with project students, though it is certainly true that most full-time students welcomed the presence of part-timers in the group. But did this diminish the learning experience in the early stages? This very important question was not a focus of this study, but is recommended as a topic for future investigation.

6. Development

The course team will continue to develop approaches to allow full-time students to benefit from contact with the part-time students. This investigation has helped to identify how this interaction is likely to be most effective. Of course this is just one element in a range of approaches to realising an 'experience-led engineering degree', including work experience, realistic project work, and inputs from practitioners.

The CP credits scheme, including the mentoring scheme, will continue. In 2011/12, the mentoring scheme is being extended so that part-time students mentor full-time students not only in their first year but also in their second year while they are engaged in the Engineering Investigation project. Composition of groups for project work will continue to be managed carefully to allow students to learn from each other, but supported by approaches to assessment that encourage this.

References

- Bird, R. and Iqbal, R. (2011) Group development in a Problem Based Learning Environment to enhance the student learning experience in the computer supported teaching of Computer Network Architecture, Planning and Management. In: Davies, J., de Graaff, E. and Kolmos, A. ed. *PBL across the disciplines: research into best practice*. Aalborg University Press, 541-554.
- Black, F.M. and MacKenzie, J. (2008) *Quality enhancement themes: the first year experience. Peer support in the first year*. The Quality Assurance Agency for Higher Education, UK.
- Brennan, J., Mills, J., Shah, T. and Woodley, A. (1999) *Part-time students and employment: a report of a survey of students, graduates and diplomats*. Department for Education and Employment.
- Callender, C., Hopkin, R. and Wilkinson, D. (2010) *Career decision-making and career development of part-time higher education students*. Report to the Higher Education Careers Services Unit, UK.
- Davies, J.W. (2008) Part-time undergraduate study in civil engineering – students from the workplace. *Engineering Education: Journal of the HE Academy Engineering Subject Centre*, 3 (1), 21-29.
- Green, A. (2007) *Peer Assisted Learning: empowering first year engagement with a formal curriculum through the educative*. pal.bournemouth.ac.uk [accessed May 2011]
- Joddrell, F. (2007) Teaching and learning in the Built Environment - a multi-level, multi-layered approach. *Proceedings of Built Environment Education Conference BEECON2007*, HE Academy: CEBE, September 2007.
- Kember, D. and Leung, D.Y.P. (2004) Relationship between the employment of coping mechanisms and a sense of belonging for part-time students. *Educational Psychology*, 24 (3), 345-357.
- Lindsay, E., Munt, R., Rogers, H., Scott, D. and Sullivan, K. (2008) Making students engineers. *Engineering Education: Journal of the HE Academy Engineering Subject Centre*, 3 (2), 28-36.
- Mason, G. and Hopkin, R. (2011) *Employer perspectives on part-time students in UK higher education*. Department for Business, Innovation and Skills, Research paper 27.
- Nicholl, H. and Timmins, F. (2005) Programme-related stressors among part-time undergraduate nursing students. *Journal of Advanced Nursing*, 50 (1), 93-100.
- Poitras, G. and Poitras, E. (2011) A cognitive apprenticeship approach to engineering education: the role of learning styles. *Engineering Education: Journal of the HE Academy Engineering Subject Centre*, 6 (1), 62-72.

- Royal Academy of Engineering (2007) *Educating engineers for the 21st century*. Royal Academy of Engineering, UK.
- Royal Academy of Engineering (2010) *Engineering graduates for industry*. Royal Academy of Engineering, UK.
- Schuller, T., Raffae, D., Morgan-Klein, B. and Clark, I. (1999) *Part-time higher education - policy, practice and experience*. Higher Education Policy Series 47, Jessica Kingsley Publishers, UK.
- Tozawa, Y. (2011) Education in business process reengineering through PBL. In: Davies, J., de Graaff, E. and Kolmos, A. ed. *PBL across the disciplines: research into best practice*. Aalborg University Press, 297-309.
- Trujillo, D. (2011) Assessment of a large and diverse civil engineering cohort in PBL – a case study. In: Davies, J., de Graaff, E. and Kolmos, A. ed. *PBL across the disciplines: research into best practice*. Aalborg University Press, 568-580.
- Yum, J.C.K., Kember, D. and Siaw, I. (2005) Coping mechanisms of part-time students. *International Journal of Lifelong Education*, 24 (4), 303-317.

Table 1 Proportion of time for topics

	Not at all	Occasionally	Some of the time	Most of the time
General conversation	1 (8%)	6 (50%)	5 (42%)	
Your work			4 (33%)	8 (67%)
The course		1 (8%)	9 (75%)	2 (17%)

Table 2 Ways of sharing knowledge, experience and understanding

	Not tried	Tried with little success	Tried with moderate success	Tried successfully
Describing current and past projects at work			5 (42%)	7 (58%)
Describing the composition of a project team or a permanent team	2 (17%)		7 (58%)	3 (25%)
Explaining who does what (and when)	1 (8%)		9 (75%)	2 (17%)

Table 3 Success in providing advice on interpersonal and organisational skills

	Not tried	Tried with little success	Tried with moderate success	Tried successfully
Teamwork	2 (17%)	3 (25%)	6 (50%)	1 (8%)
Time management		2 (17%)	8 (66%)	2 (17%)
Communication	1 (8%)	4 (33%)	3 (25%)	4 (33%)